# How Your Immune System Works

## Thymus

The thymus lives in your chest, between your breast bone and your heart. It is responsible for producing T-cells (see the next section), and is especially important in newborn babies - without a thymus a baby's immune system collapses and the baby will die. The thymus seems to be much less important in adults - for example, you can remove it and an adult will live because other parts of the immune system can handle the load. However, the thymus is important, especially to T cell maturation (as we will see in the section on white blood cells below).

### Spleen

The spleen filters the blood looking for foreign cells (the spleen is also looking for old red blood cells in need of replacement). A person missing their spleen gets sick much more often than someone with a spleen.

### Bone marrow

Bone marrow produces new blood cells, both red and white. In the case of red blood cells the cells are fully formed in the marrow and then enter the bloodstream. In the case of some white blood cells, the cells mature elsewhere. The marrow produces all blood cells from **stem cells**. They are called "stem cells" because they can branch off and become many different types of cells - they are precursors to different cell types. Stem cells change into actual, specific types of white blood cells.

### White blood cells

White blood cells are described in detail in the next section.

Antibodies (also referred to as immunoglobulins and gammaglobulins) are produced by white blood cells. They are Y-shaped

proteins that each respond to a specific **antigen** (bacteria, virus or toxin). Each antibody has a special section (at the tips of the two branches of the Y) that is sensitive to a specific antigen and binds to it in some way. When an antibody binds to a toxin it is called an antitoxin (if the toxin comes from some form of venom, it is called an antivenin). The binding generally disables the chemical action of the toxin. When an antibody binds to the outer coat of a virus particle or the cell wall of a bacterium it can stop their movement through cell walls. Or a large number of antibodies can bind to an invader and signal to the complement system that the invader needs to be removed.

Antibodies come in five classes:

- Immunoglobulin A (IgA)
- Immunoglobulin D (IgD)
- Immunoglobulin E (IgE)
- Immunoglobulin G (IgG)
- Immunoglobulin M (IgM)

Whenever you see an abbreviation like IgE in a medical document, you now know that what they are talking about is an antibody.

For additional information on antibodies see The Antibody Resource Page.

The complement system, like antibodies, is a series of proteins. There are millions of different antibodies in your blood stream, each sensitive to a specific antigen. There are only a handful of proteins in the complement system, and they are floating freely in your blood. Complements are manufactured in the liver. The complement proteins are activated by and work with (complement) the antibodies, hence the name. They cause lysing (bursting) of cells and signal to phagocytes that a cell needs to be removed.

For additional information on complements, see The Complement System.

## Hormones

There are several hormones generated by components of the immune system. These hormones are known generally as **lymphokines**. It is also known that certain hormones in the body suppress the immune system. Steroids and corticosteroids (components of adrenaline) suppress the immune system.

Tymosin (thought to be produced by the thymus) is a hormone that encourages lymphocyte production (a lymphocyte is a form of white blood cell - see below). Interleukins are another type of hormone generated by white blood cells. For example, Interleukin-1 is produced by macrophages after they eat a foreign cell. IL-1 has an interesting side-effect - when it reaches the hypothalamus it produces fever and fatigue. The raised temperature of a fever is known to kill some bacteria.

For additional information see Manifestations of Infection: Fever and IL-1.

## Tumor Necrosis Factor

Tumor Necrosis Factor (TNF) is also produced by macrophages. It is able to kill tumor cells, and it also promotes the creation of new blood vessels so it is important to healing.

## Interferon

Interferon interferes with viruses (hence the name) and is produced by most cells in the body. Interferons, like antibodies and complements, are proteins, and their job is to let cells signal to one another. When a cell detects interferon from other cells, it produces proteins that help prevent viral replication in the cell.